VOL. 2 NO. 8 August 1985

COMPUTER DIGEST

NEW KIND OF MAGAZINE FOR ELECTRONICS PROFESSIONALS

DIGITIZING TABLETS:

Keyboards Aren't The Only Way To Enter Data

Build The CASSETTE-TO-CASSETTE INTERFACE

For Drudgery-Free Tape Copying

A GERNSBACK PUBLICATION

DELUXING THE COLOR COMPUTER

Make Your Color Computer Perform Like The Expensive Models

Electronics Paperback Books

Secrets of the COMMODORE 64
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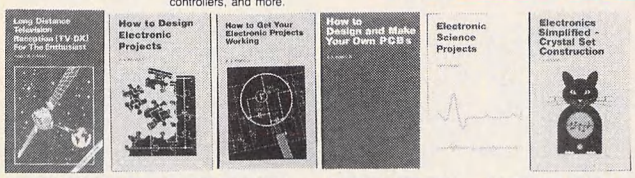
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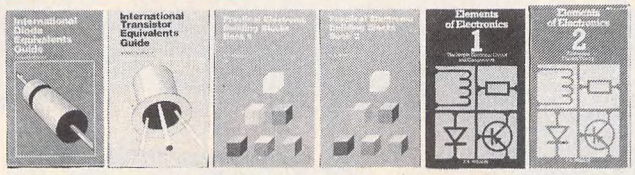
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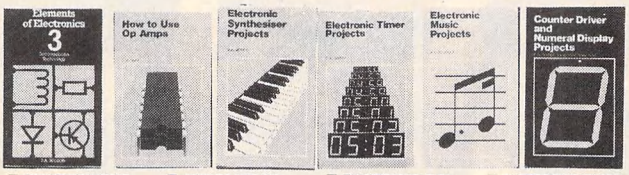
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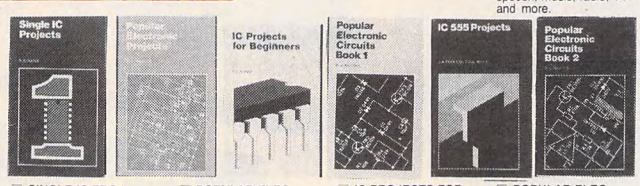
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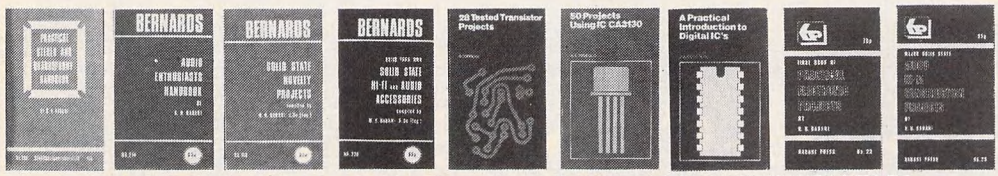

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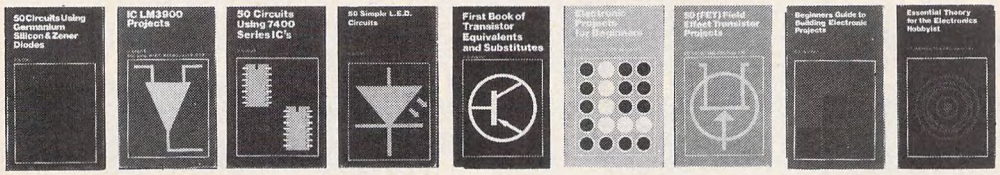
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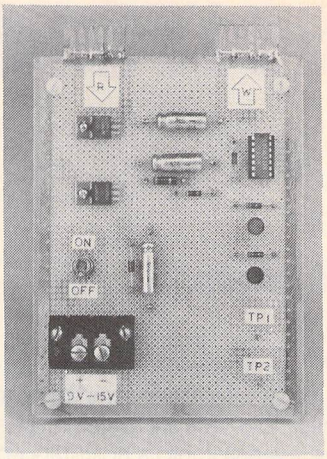

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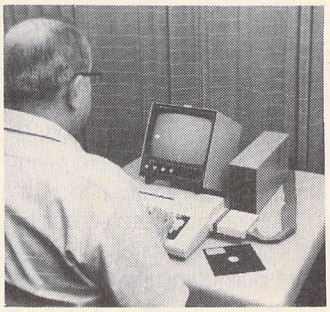

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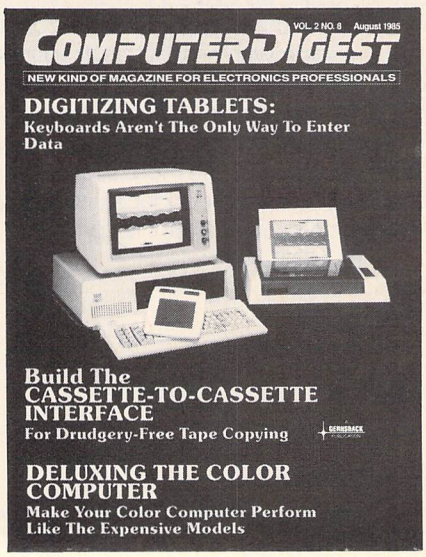
ON THE COVER

Inputting without the classic keyboard can be done in many ways. Here we see the Koala Pad from Koala Technologies being used with an IBM computer. See page 8.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DELUXING THE COLOR COMPUTER
Make Your Color Computer Perform Like The Expensive Models

COMING NEXT MONTH

Touch Screens
Sensitive Video Display Terminals provide still another—simple—way to input information.

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Here's how to get more than 5 seconds of synthesized speech with 16 K.

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EDITORIAL

Hackers.

■A "Computer Hacker" is a thief. A crook who uses his computer to attempt to break into other computers and leave evidence that he has done so. These low-lifes try to get into bank computers and louse up the records, one even got into a hospital's computer and did so much damage to the records that lives were actually jeopardized. They try to get into school computers and screw up those records too.

Some of them have successfully broken into classified government computer systems, endangering the security of our country. They form clubs and swap coded information, they have magazines that offer tips to improve their skills.

We'd like to go on record. We're anti-hacker. These thieves, for that's exactly what they are, are giving *all of us* a bad name. They've been getting a lot of publicity lately, and it's all bad. Sure, they try to come off as "boy genius" types that are so adept at using their computers that they can foil the most-professional anti-hacker security systems. But break down what they're doing and how they're doing it, and you see that all they do is nothing but drudgery, repeating and repeating with minor changes until they break in. There is nothing at all intelligent about what they do, and especially the way in which they do it. If they *do* manage to break a code, it's usually the result of a freak accident. Certainly not the product of any intelligence on their parts.

Hackers are morons with computers. They've got nothing else to occupy their minds, they're hungry for a little notoriety, and for my part, they should be treated as exactly what they are—crooks. There's no redeeming quality at all in them, they are *not* to be admired, and what they're doing hurts all of us.

How? I saw the same thing happen in amateur radio, later in CB. The good guys have to take the heat for the bad guys. Some guy with a signal squirter louses up every TV in the neighborhood, and any ham that tries to put up an antenna gets dirty looks from the neighbors.

It's the same with computers. If your neighbors know you have a computer, and they see the news stories about what the horrible hackers are doing, you're going to be painted by the same broad brush.

You may have a friend who hacks. If you do, do him a favor. Redirect his thinking into something more substantial. Get him involved in baseball, or stamp collecting, or introduce him to a girl.

Just get him away from his computer.

Byron G. Wels

Byron G. Wels
Editor

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LETTERS

Can Someone Help?

I own a Timex 1000 and a TVRO Earth Station. I'm searching for a program to plot stationary satellite positions from different parts of the U. S. I'm sure lots of your readers would be interested in a program such as this.—William Scott, Manteca, CA.

Bill, that sounds like a great idea! I'll refer it to our Software Review Editor, and if he can't come up with something, perhaps one of our readers can.

Archival Programs?

I don't know if anybody has ever done this before, but I've put my family tree on a disc, along with some personal annotations and I'd like to store this for posterity. How can I protect that disk?—Martin Resnick, St. Paul, MN.

We've never heard of this before Martin, so all we can do is make some suggestions: Begin by using the very-best quality disk that you can buy, and then wrap it in aluminum foil twice. The second sheet covers the wrapped and folded areas of the first sheet. This should help protect against stray magnetic fields. Put it between sheets of heavy cardboard to protect it from bending, and place it in an envelope sealed with heavy tape. Add a few packets of silica gel too. And good luck!

Understanding guy

I understand that mistakes can happen, Lord knows I've made my share too. But how can a reader tell if there's a mistake in the project he's planning to build from a magazine? It isn't just your magazine—it happens in all of them! Is there a way to protect against this?—Roger Touhey, Sioux Falls, SD.

Roger, thanks for being so understanding. Yes, authors can make mistakes, editors can let something slip, the proofreaders might not catch an error, and typesetters have been known to hit the wrong keys occasionally. Errors do creep in, despite our best efforts. But it doesn't happen as often as you might think, for we do try to be careful! One way is to save the "hot project" for a couple of months and watch the magazine for corrections.

COMPUTER PRODUCTS

For more details use the free information card inside the back cover

COMPATIBLE VIDEO I/O BOARD, model *DT2803*, is a video frame-grabber and display board for the IBM PC and PC/XT. The model *DT2803 captures a 256 × 256 × 6 black-and-white image, and the R-G-B output handles 64 colors × 64 intensities and includes cursor control. In combination with the Videolab* software package, the model *DT2803* is ideal for applications in industrial robotics, inspection, and assembly, as well as medical imaging and graphic arts.

The *Videolab* package is an easy-to-use software for real-time video digitization and display with the DT2803. It is divided into two major sections: Videotutor and Videosub. Videotutor is an interactive, command-driven tutorial program that allows first-time users to become familiar with the model *DT2803* video I/O board within a user-friendly programming environment. Videosub is a comprehensive

CIRCLE 21 ON FREE INFORMATION CARD

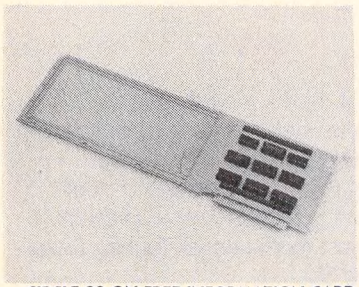
library of subroutines for user-defined applications programs; callable from BASIC (interpreted and compiled), C, PASCAL, and FORTRAN, Videosub supports all the functions of the model *DT2803*.

The model *DT2803* board is shipped complete, with a comprehensive user manual and demonstration diskette, including sample programs. The single-unit price for the model *DT2803* is $1495.00. Videolab is shipped on a single-sided, double density diskette, and includes a comprehensive user manual; the price is $995.00.—*Data Translation,* 100 Locke Drive, Marlboro, MA 01752.

PROTOTYPING BOARD, the *eZ Card,* is a blank circuit board for computer hobbyists or engineers who wish to build a prototype board according to specific design. The board provides the means to interface prototype circuitry for the IBM-PC with several features. A switch-selectable address decoder frees the user to concentrate on design. Selector switches permit up to eight boards to be installed in a single PC system.

Two areas are available for building prototype circuits on this large, full-slot sized board, one of which is situated for installation of I/O connectors. The larger prototype area consists of a grid of over 2,300 plated-

through holes on 0.1-inch centers, suitable for installing over 60 wire-wrap sockets.



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The *eZ Card* uses sockets for all buffer IC's and a gold-plated edge connector for maximum reliability of operation.. A mounting bracket is provided for permanent installation into the PC system housing. The board comes with documentation that includes experimental circuits and related basic application programs for each circuit. It is priced at $89.95—$5.00 shipment from stock to four weeks.—*Sabadia Export Corporation,* PO Box 1132, Yorba Linda, CA 92686.

DISK DRIVE, the Commodore *SFD 1001,* is enclosed in a 1541-sized case and has a one-megabyte storage capacity on a double-sided, double

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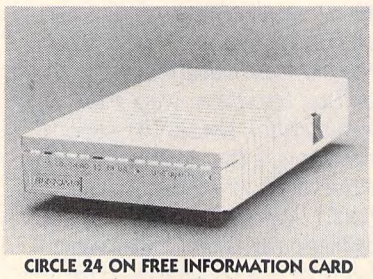
density format. A utility disk with 64 and 8032 utilities is included with the disk, and an optional serial IEEE connector and cabeling is available. The *SFD 1001* is priced at $399.95—*Progressive Peripherals & Software, Inc.,* 2186 South Holly, Denver CO 80222.

PERSONAL-COMPUTER MODEM, the *IntelliModem EXT,* is a standalone 300/1200 baud communications system suitable for use with *any* serial RS232-equipped computer or terminal. It features an exclusive voice-insert capability, which allows use of an ordinary phone to add integrated voice to a personal-computer work station. The user may talk and listen, or send and receive data without having any need to hang up and redial.

A front-panel multicolor line-quality bargraph display dynamically monitors the telephone-line condition. Call-progress detection lets the modem electronically sense telephone-system



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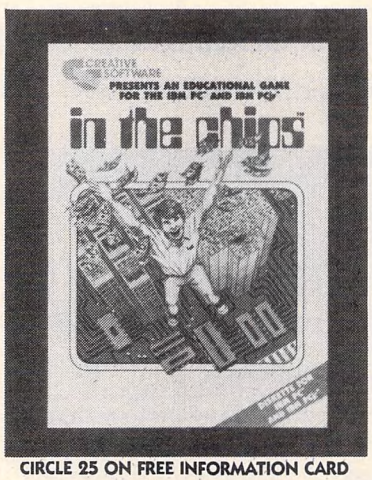
signals such as Busy, Dial Tone, Remote ringing, and Voice, and display those conditions on the computer screen. Thus, the user always knows what is happening as the call progresses.

The *IntelliModem EXT* is priced at $499.00—*Bizcomp,* 532 Mercury Drive, Sunnyvale, CA 94086.

EDUCATIONAL PROGRAM, *In The Chips,* is available for owners of IBM PC, PCjr., and Commodore 64 home computers. It challenges both children and adults to create a profitable software business. An initial investment of $100,000 is used to develop, inventory,



CIRCLE 25 ON FREE INFORMATION CARD

price, and advertise computer games. Using the joystick, players manipulate assistants, who go from building to building carrying out orders. At the end of each quarter, a balance sheet appears so that players can see how well their companies are doing.

In The Chips is priced at $29.95.—*Creative Software,* 230 East Caribbean Drive, Sunnyvale, CA 94089.

RADIATION SHIELD, the *Eye-Guard,* is a device that protects people from the glare and radiation that is emitted

CIRCLE 26 ON FREE INFORMATION CARD

from video-display terminals (VDT's). The anti-glare screen is made from nylon netting while the anti-radiation shield is made with lead-impregnated acrylic. (*Eye-Guard* contains 30% lead by weight.)

Eye-Guard is affixed to the face of the terminal with Velcro tabs. It eliminates glare and cuts off all the X-rays, microwaves. and ultraviolet waves that VDT's emit. (It is estimated that a worker who sits in front of a black-and-white terminal for 35 hours per week could receive the equivalent of 30 chest X-rays in a year's time.

The Eye-Guard is priced at $129.95, and comes with a 100% money-back guarantee that it will stop even the worst case of eye fatigue resulting from unshielded VDT's.—*Langley-St. Clair Information Systems, Inc.,* 132 West 24th Street, New York, NY 10011.

DISK MARKERS, the *Diskribe* (shown) and the *Label Pen* are designed specifically for use on computer software. The *Diskribe* can be used directly on computer software disk sleeves for safe identification and reference. The ink is quick-drying and permanent, and the markings do not affect information on the disk itself. The *Label pen* is designed for use on slick-finish and other hard-to-mark labels currently being used on disks, diskettes, and VCR cassettes. The fine point and high-intensity permanent ink makes writing easier to read on small labels.

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The *Diskribe* is priced at $2.50; the *Label Pen* costs $1.00.—*Sanford Corporation,* 2740 Washington Boulevard, Bellwood, IL 60104.

SOFTWARE REVIEW

Seekeasy

■SEEKEASY is a free-form database designed for rapid storage and retrieval of randomly-entered reference information.

Unlike conventional data management programs which cannot search using *keywords* having little relationship to the original data entries, SEEKEASY can locate entries if only a few characters of a *keyword* are correct.

For example, assume that it was possible to load a conventional database with randomly entered data, and over a period of time you had entered many references for an article on test equipment. Now you want to extract the data on a particular meter that you key in as *Simsun*. To the typical database there is no way it will know you mean *Simpson*. But a free-form database such as SEEKEASY will locate the closest matching string anywhere in the file, and in a few seconds it will match *Sim* to *Simpson* and extract the correct information.

In searching for data SEEKEASY doesn't care care if the original entry, the search criteria, or both are incorrect. Somehow, it will locate the data quicker than you can look up the correct spelling of a *keyword*(s) in a dictionary because it attempts to match every possible string in the keyboard entry to every conceivable string in the data record. Assume you are using SEEKEASY as an electronic Rollodex and entered the continuous string record:

Buck Rogers, Colossal Mfg., 456 Third St., Muggersville, NY 11217, 1-212-555-5555. Manufactures gizmos.

You need to purchase gizmos but can't remember anything about the manufacturer. SEEKEASY will locate the data even if you make a mistake and key in *giztes* instead of *gizmo*. It might be buried in a screen display containing 99 other items with the string *giz*, but it will be on the screen.

While *giz* is a partial string, even a complete string locates many matched entries. If you wanted to extract the data on a *drill bit* and only entered *bit* as the *keyword*, SEEKEASY will locate *drill bit, drillbits, bridle bit, bitter, bite, illegal* and *illness* (the *ill* matches); it will locate the entry for your friend Bill (the *bil* match). SEEKEASY will often come up with a list of matches which have no relationship to what you're looking for, but the desired data record will be in the list. The greater the degree of matching in one or more *keywords* the closer the desired data will be to the top of the listing. In the above instance, *Bill* would be well down on the list of matches.

The only limitation on matching are one and two letter words—they must be an exact match. An *A* cannot locate a *W* and *at* will not locate *an*. Other than these conditions anything goes.

Regardless of the number of records in a file—it might be thousands—SEEKEASY displays up to a maximum of 100 records at the rate of seven records per screen: pressing *RETURN* scrolls the next seven onto the screen. The speed with which SEEKEASY can locate a data record depends on the length of the data file and the storage media. Floppy disks are searched at 5-KB/second; hard disks at 7-KB/second, and RAMdisk at 10-KB/second. Dump a full 360-KB floppy data disk into a RAMdisk the longest it takes to locate a data record is 36 seconds.

SEEKEASY data records are limited to two lines of 155 characters. Records are prepared directly by SEEKEASY's own internal and somewhat rudimentary word processor, with editing done through the cursor positioning keys. While the simple editing commands don't make for much of a word processor, it does what's needed and beats having to prepare files with a separate word processor. Pressing *RETURN* enters the record in the data file and resets the program for the next data record, with the previous entry displayed at the top of the screen so the user can keep track of the entered records.

Old records can be deleted. A special *Check File* mode displays the free space on a disk in available characters, and the number of characters in the active data file. When the disk holding the data file is almost full, SEEKEASY prints warnings on the bottom line of the screen during store and edit operations. If the user insists on ignoring the warning (about 5-10 more records) SEEKEASY refuses to store additional records until more disk space is made available.

While the supplied manual generally refers to a single data file, the user can create several individual data files on the same disk, of which several or all can all be merged into larger files if desired.

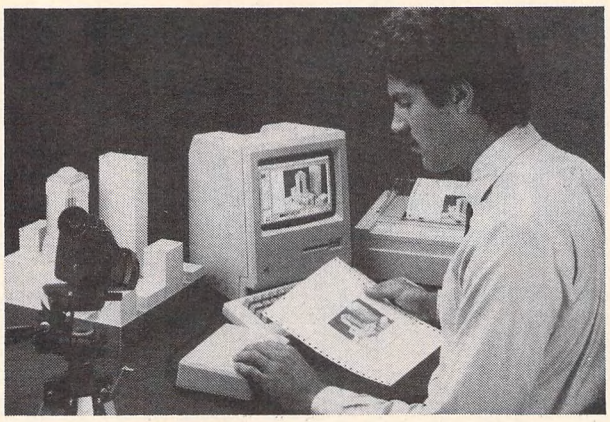
Finally, SEEKEASY can find any 7/8 bit ASCII character in any data, .COM or .EXE file. If it's in a disk file and it's in ASCII SEEKEASY will find it.

SEEKEASY is entirely menu driven. A CONTROL-T prints hardcopy of either the screen display or the entire datafile.

That's all there is to SEEKEASY. There are no complex commands, no unusual text files, and no structure of any kind. But it is extremely fast and convenient. In fact, Seekeasy is so fast and easy to use that it can be learned from a short *doc* disk.

SEEKEASY, Price $90 postpaid U.S. and Canada, $18 for demo disk (refunded on purchase). Correlation Systems 81 Rockinghorse Road Rancho, Palos Verdes, CA 90274. Available for PC-DOS and MS-DOS Requires: DOS 2.0 or higher, 128K of RAM, One or more floppy drives, Monochrome or color monitor.◀CD▶

DIGITIZING TABLETS



All you ever wanted to know about digitizing tablets—and didn't know who to ask!

MARC STERN

■One of the long-sought developments in the world of microcomputers has been the marriage of hand input with the small-computer system. Hand input makes a small computer system more flexible. A hand input device allows anyone to work as if using a pen and paper.

In the last two years, this has come about thanks to the digitizing tablet. Manufactured by companies such as Koala and Pencept, Inc., digitabs take the theory of dynamic character recognition technology, an outgrowth of artificial intelligence research, and put it into practice.

A device such as Pencept's *Penpad* or Koala's *Koalapad* is actually a digitizer with a stylus or pen and a connection to its host computer. Such a device can easily send drawings, special commands and cursor controls to a host IBM Personal Computer or compatible, such as the Compaq. The *Penpad* can also double as a touch-pad or mouse.

Older input methods

In the past, users relied on optical character recognition devices (OCRs) or bar-code readers to input handwritten data from a sheet of paper into a small-computer system. While these methods of handling data-capture are fast compared to more laborious manual input methods, they still aren't totally acceptable.

One drawback with OCRs is that the hand-printing has to be recognizable to OCR optics or the input is unusable. Users receive special training to ensure their hand-printing styles match OCR specifications. OCRs also force users to invest in reading devices that are expensive and difficult to maintain in some environments. Finally, OCRs are incapable of instant information updates.

Instead of direct entry into a system, the information must first be printed on a special form and then read into the system for processing.

Bar-code readers can speed information input, but, like OCRs, need special equipment and software. Bar-code readers require a light wand or pen to read coding strips called Universal Product Codes (UPCs)

FIG. 1—UNIVERSAL PRODUCT CODES are one method of data input. Special readers interpret the strip and convert the information into useable data for a computer.

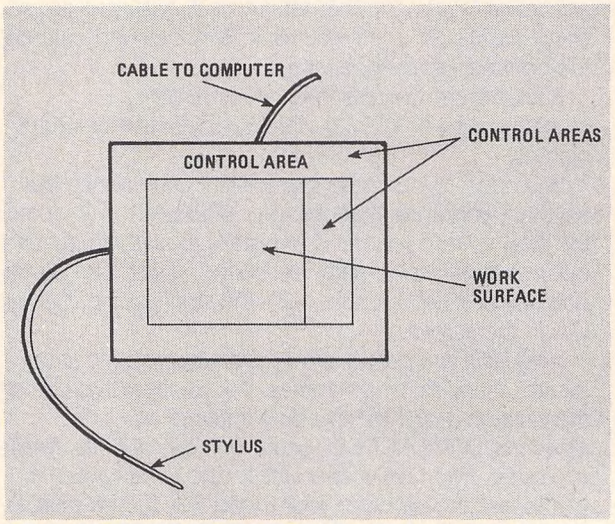


FIG. 2—WORKING WITH A STYLUS, a Digipad will turn written or printed information into data on a screen.

(See Figure 1.) These readings are interpreted by software that recognizes each UPC strip and determines its significance. Any time UPCs change, the reader's software is updated. For some users, bar-code readers are alternatives to OCRs

Digitizing tablets offer many advantages over both OCRs and bar-code readers. Like a bar-code reader, they allow quick information input to an IBM PC's 8088 central processor, but, unlike a reader, they have greater flexibility in the variety of input, much like an OCR. Although digipads (DIGItizing penPADS) are more sophisticated than either device, they boast a simple design, consisting of a writing tablet, pen or stylus, an interface board that slips into one slot in the PC and the software. (See Figure 2.)

Digipads are as easy to use as applying pen to paper. The computer keyboard is replaced by the tablet and stylus—attached to it by a cord—resembling the traditional clipboard-and-chained-pen. Digipads can recognize a variety of handwriting and can acknowledge capital letters A-Z, numerals 0-9, and other characters. Some pads, such as the *Penpad*, use fixed height reference points to determine if the input is capital or lowercase. *Penpad* assumes lowercase when uppercase letters are written at half-height (Fig. 3). These devices also handle deletions with special

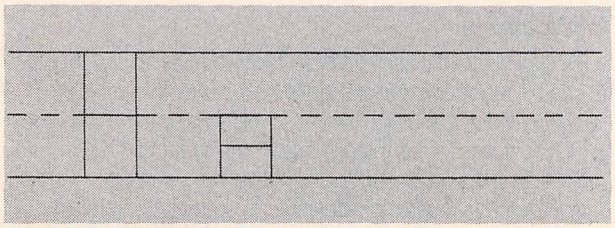


FIG. 3—IN MOST CASES, letter height determines a letter is capitalized or is lower case.

command characters or the input can be overwritten, as with a keyboard and screen Digipads can enter calculations, documents, forms and more directly into the computer, bypassing third channels.

Digipads function as graphics digitizers by providing the computer with information about the location of the stylus relative to its surface. This is translated into a specific address in the computer's memory; the cursor is then moved to that location on the monitor. So it is possible to send freehand drawings or tracings such as map contours or circuit drawings to a host PC. You can use pre-prepared or hand-drawn forms and turn them into quality graphics with a few sweeps of the pen across the tablet's face. The digitizer's built-in intelligence blends both graphics and hand-printed text to create presentation-quality material.

Digipads can also function as touch pads. A touch pad is a low-resolution digitizer that recognizes when the stylus touches specified areas on its surface. On a device such as the *Penpad*, the pen is equipped with a pushbutton that acts as a trigger to transform it into a "mouse that writes." The "mouse-mode" offers quick cursor movement to any spot on a page, by drawing a line with the pen in the appropriate direction on the tablet. As it is moving, the *Penpad* analyzes penstrokes as they are being made, identifies the characters being formed and presents them to the host computer in a manner indistinguishable from routine keyboard input.

Making it work

The digipad recognizes characters that vary greatly in form through dynamic character recognition (DCR) technology. Using the *Penpad* as an example, the designers used both common generative and perceptive OCR rules to create the algorithm that allows *Penpad* to work. The generative rules deal with character formation; the perceptive rules describe the way people see characters. The first concept is based on set patterns of character generation (for example, the letter A is usually formed in a similar manner by most persons); while the second relies on the fact that most persons generally perceive letters or graphics in the same manner.

In many aspects, the digipad acts as a computer terminal, except that the writing tablet and pen, which form the basis of the unit, replace the keyboard. It supports a high enough X-Y resolution (200 points per inch) as well as a high enough point-sampling rate (200 points per second) to handle the rapid movements a user makes when writing with quick short strokes, as in forming small characters, or when using letters with long strokes (capital letters).

A digipad usually employs its own microprocessor—the *Penpad* uses an MC-68000—whose speed is fast enough to respond to up-and-down pen movements up to eight times per second.

A digitizing tablet is capable of capturing as much as 2,000 bits of raw data and this data must be processed before it is used by the computer. It is at this point that Read-Only Memory (ROM)-based firmware takes over. It preprocesses the raw data, removing unimportant hooks, loops, swirls and extraneous electronic noise. It standardizes the size of the characters that are printed on the tablet. Further processing cleans the raw data making it look like ink images on paper as closely as possible.

At this point, the generative and perceptual rules used by the device are brought into play. The algorithms used in the software determine which letters the data represent. The software must analyze the structure of the input and select the letter the structure represents. For example, the numeral 2 is almost always formed starting at the top, and this is the only way the software will recognize it, even though a normal-looking 2 might be formed starting at the bottom or from any other position. See Figure 4.

Systems revealed

If you look at a typical digipad, you will see it's a little larger than the standard three-ring notebook. The writing surface is subdivided into grids, an example of which might be six boxes per inch horizontally and four per inch vertically. The digipad's surface is programmable and allows the user flexibility in resetting these parameters. A user can also define some areas of the digipad's surface to accept only certain characters and some digipads also are capable of

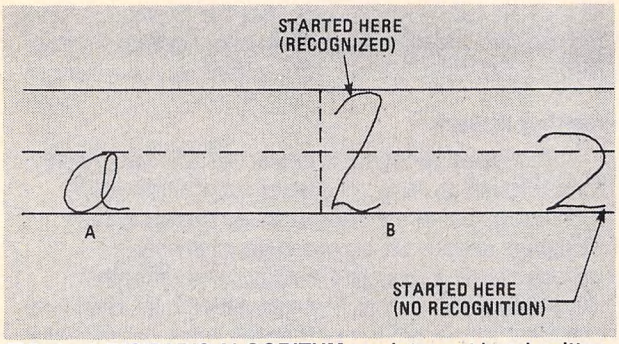


FIG. 4—A DIGIPAD'S ALGORITHM can interpret hand-written data. Since letters are formed in the same manner, the program will recognize the loops of an "A." Likewise, it will recognize a "2" which is usually started at the top. If somebody starts a "2" at the bottom, the program can't recognize it.

handling macros.

(Macros are programmable routines in which one stroke handles several functions. Suppose you have several complicated command sequences in a program which also has macro capability and you want to streamline things. Using the program's macro capability, you can establish a one- or two-key sequence to handle the multi-command sequence by opening the macro and entering all the complicated commands you must. When you are finished, you close the macro and either assign it a name or key and every time you need the complicated command sequence, rather than hitting many keys, you only have to hit one and the program handles it for you.)

Using a digipad's macro capability lets you transmit a string of user-defined characters at the touch of the stylus.

If you look at the surfaces of some digipads, you will see a control area. This area allows you total control of editing and alphanumeric, as well as program functions. It acts in place of the keyboard.

To work with an IBM PC or compatible system, you or the company providing the system will have to write a driver routine. It is this program which lets the digipad act as the "front end" of your system. With the PC, it's easy, because you can take advantage of DOS 2's (and higher) CONFIG.SYS routine. With this routine, you open a small text file and input the following line DEVICE = XXXXX and then close the file. You install this file on the disk you are using and the PC will look for it every time you boot your system. This structure is enough to tell the PC to install the digipad. The CONFIG.SYS routine also eliminates the need to write complicated patches to the operating system, although some manufacturers may do that for you in the software they provide for their pad.

Typically, a digipad is driven by a microprocessor. Whatever microprocessor is used, it gives the digitizer its capability. In an IBM-PC this controlling circuitry interfaces with the IBM bus through one of the expansion slots on the motherboard. This add-on board will contain the microprocessor and any ROM-based firmware needed by the system to handle its chores. For instance, the *Penpad*'s 68000 microprocessor is on this board, as is its 128K of ROM firmware, 128K of Random-Access memory for user input and 4K of nonvolatile memory used to store format and command information, as well as parameters for setup as a terminal. Input and output to the digipad is handled as straight ASCII information.

A typical digipad can be interfaced as either a serial or a parallel device. As a serial device, it can be made functionally equivalent to an RS-232C port—as is done with the *Penpad*—without tying up the port itself. The developers will locate the device's input at the memory address of a serial port and the system thinks there is a serial port attached, in reality, any other serial devices are free. The IBM-PC supports up to three serial ports and a digipad can reside at any of those locations. Usually, it will be port 2 or 3 because port 1 is taken up by a communications card.

As a parallel device, it is functionally equivalent to a peripheral such as a parallel printer and will reside at the printer's location in memory. Of course, a parallel device is capable of communicating at higher speeds than a serial device because of the parallel data stream used, but, a serial device can be used a greater distance away.

Typically, a digipad will operate in parallel with the keyboard and you can usually use it with the keyboard installed.

Implications

A digipad will eliminate redundant keyboard input in many situations where data entry forms must be rekeyboarded or read into a computer system through an OCR. It provides instant, real-time data updating and will increase system efficiency and throughput.

Further, it will prove attractive in graphics, scientific or electronics work. In graphics, it gives a computer user the ability to design attractive lettering or figures quickly and easily, without the necessity of using a keyboard. It frees the designer to sit and use a device much like a pen and paper and the designer will be able to use the freeform methods he's used to. The same is true of the computer user who wants to design his own graphics output. In a scientific atmosphere, a digipad user can enter equations and computations from a "scratchpad" and could have the new information displayed immediately. An electronics enthusiast will be able to design a circuit on paper and have it immediately translated into a high quality output. If he makes any changes to the circuit, they will be displayed immediately.

The digipad will prove very attractive in situations which don't lend themselves to transition to keyboards or terminals. Data entry, in these environments, often lends itself more readily to the freeform modes allowed by handprinting, rather than the rigid standards imposed by a traditional keyboard. Often simple inventory can be handled more easily by a simple form than by a computer terminal.

Digipads provide an easy interface to computers and their capabilities. It speeds data entry time and allows much more freedom than a traditional keyboard. In the future, such devices will become more and more common for more users.◀Φ▶

COMPUTER BOOKS

For more details use the free information card inside the back cover.

■MICROPROCESSOR BASED ROBOTICS, By Mark J. Robillard. Howard W. Sams & Co., Inc., 4300 W. 62nd Street, Indianapolis, IN 46268. 220 pages including index. 8½ × 11 inches; softcover; $16.95.

If you want to learn more about intelligent machines, this book serves as an excellent introduction to the subject. Designers, experimenters, and students will find the work equally valuable. Robillard disects robotics into their logical, scientific areas of engineering, and shows how they can be made to achieve pseudo lifelike mechanization to control such things as mechanical, electrical, electronic or computer-based operations.

He covers specific subjects within each technical discipline and explains in detail, each robot-element of the construction. Many hands-on projects are included, making this an ideal classroom text.

CIRCLE 31 ON FREE INFORMATION CARD

SOFTWARE MASTER FOR PFS: By Ted Leonsis and LIST Magazine. Warner Software/Warner Books, 666 Fifth Avenue, New York, NY 10103. 221 pages, 8 inches × 9¼; softcover; $14.95.

Software Master for PFS offers reviews of each program based on critical and lengthy interviews with actual users in the field. With added editorial comment on each program's documentation and tutorials by the authors, the result is useful and reliable.

CIRCLE 32 ON FREE INFORMATION CARD

A HOBBYIST'S GUIDE TO COMPUTER EXPERIMENTATION: By John D. Lenk. Prentice-Hall, Inc. Englewood Cliffs, NJ 07632. 283 pages including index. 6 × 9¼ inches; hardcover; $25.95.

John D. Lenk is a long-time author in the electronics field, and in this work, it's easy to see why. The book is complete, innovative, and fascinating reading that will prompt you to attempt some of the experiments as soon as you put the book down. Everything is clearly explained, and lucidly illustrated with easy to follow diagrams and photographic illustrations. Prentice-Hall, the Publishers, have done the work proud.

CIRCLE 33 ON FREE INFORMATION CARD

VIC 20 USER GUIDE: By John Heilborn & Ran Talbott. Osborne/McGraw-Hill, Inc., 2600 Tenth Street, Berkely, CA 94710. 250 pages including index, 6½ × 9 inches; softcover; $14.95.

If you own or plan to own a Commodore VIC 20 you'll find that this guide is an almost essential tool. You'll find detailed operating instructions, both for the basic computer and its peripherals.

CIRCLE 34 ON FREE INFORMATION CARD

INTERFACING TO S-100 IEEE/696 MICROCOMPUTERS: By Sol Libes & Mark Garetz. Osborne/McGraw-Hill, 630 Bancroft Way, Berkeley, CA 94710. 321 pages including index, 6½ × 9¼ inches, softcover; $15.00.

The popularity and wide acceptance of the S-100 IEEE/696 Bus warranted the need for this new title. The book helps users expand the utility and power of their systems. It describes its mechanical, functional and electrical design along with bus interconnections, bussing techniques and interfacing to RAM, ROM and the real world. This is a must for any designer involved with the S-100 bus.

CIRCLE 35 ON FREE INFORMATION CARD

FREE SOFTWARE FOR THE IBM-PC: By Bertram Gader & Manuel V. Nodar; Warner Books, 666 Fifth Ave., New York, NY 10103. 466 pages including glossaary. 5¼ × 8 inches, soft cover; $8.95.

If you have or contemplate purchasing an IBM*PC*, then this book can quickly pay for itself. It's a listing of more than 600 software programs that you can get free via telephone hook-up. All are in the public domain, so there are no legal problems in availing yourself of them.

CIRCLE 36 ON FREE INFORMATION CARD

COMPUTER COMMUNICATION TECHNIQUES: By E. G. Brooner & Phil Wells; Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, IN 46268. 142 pages including index. 6 × 9 inches, soft cover; $15.95.

This valuable text, fully illustrated with photographs and line drawings, will tell you how to get your computer to "talk" to another computer, what hardware and what software you need, how to tell what will or won't work with your computer. How to connect your computer to telephone lines, the "standards and protocols" used by information services and time-sharing networks, how to access and use information services such as CompuServe and The Source. How to use Videotex and teletext systems and how they operate.

CIRCLE 37 ON FREE INFORMATION CARD

8088 ASSEMBLER LANGUAGE PROGRAMMING:THE IBM *PC*: By David C. Willen & Jeffrey I. Krantz; Howard W. Sams & Co., Inc. 4300 West 62nd Street, Indianapolis, IN 46238.235 pages including index. 8 × 9½ inches, soft cover; $15.95.

This well-illustrated book teaches you how the IBM Personal Computer works, all about the 8088 microprocessor and other important computer components. ◀CD▶

CIRCLE 38 ON FREE INFORMATION CARD

CASSETTE-TO-CASSETTE INTERFACE

Here's a way to make bulk copies of programs and save all that tedious work.

BILL TULEJA

■Making back-up copies of programs on tape cassettes can be a real chore. The program must be loaded into the computer from your original cassette, then the blank back-up cassette must be swapped for the original and the program saved on the back-up. This process must be repeated for each program on the original. The circuit described here permits bulk back-up copying. It is an interface circuit that allows two Commodore cassette tape recorders to be connected for directly reading and writing.

The connection between a Commodore computer, and its data cassette recorder is shown in Figure 1. This shows the cassette recorder's cable connector as it would be seen if you held it looking into the hole in the connector housing with the contact fingers at the top of the hole. The edge-connector of a Commodore computer is also shown as it would plug into the cassette cable's connector socket—with the contacts on top of the board. Contacts are identified by the numbers 1 through 6 along with their function names and signal directions (the computer supplies power and ground to the cassette recorder so the direction of both of these signals is from the computer edge-connector to the cable connector attached to the recorder). Connections to pins 1, 2, 3 and 4 are needed to read data out of the data cassette recorder and connections to pins 1, 2, 3, and 5 are needed to write data into the recorder.

The Commodore cassette tape recorder does not use the two-frequency FSK (*Frequency Shift Keyed*) system found on many other computers, but uses a digital pulse sequence to store data. The interface shown in Figure 2 is a digital circuit. Using an external power supply, it provides the DC voltages and logic level signals needed to interface two Commodore data recorders.

The most important part of this circuit is IC3—a 74LS14 hex Schmitt-trigger inverter. Its main function is to accept a READ input on IC3 pin 1 and produce a WRITE output on IC3 pin 2.

The circuit (see Fig. 2) is powered externally by 9V to 15V brought into terminal strip TS1. Switch S1 provides power control so the external power supply does not have to be turned on and off. Diode D1 protects the circuitry against reverse polarity if the power supply is accidently connected backwards to TS1. Capacitor C1 provides filtering for the inputs of the voltage regulators IC1 and IC2. IC1, R1 and R2 produce +6V for the cassette recorder motors. IC2 produces +5V for the logic in the cassette recorders and the circuitry on the interface board. Since IC3 contains six inverters, it was convenient to provide buffered outputs for driving LEDs. LED1 is on when connector pin 4 of the READ cassette is inputting a logic low. LED2 is on when the READ cassette is inputting a logic high. Test points TP1 and TP2 provide a buffered output for connecting an audio amplifier or oscilloscope to monitor.

Construction

The prototype was assembled on a plug-in

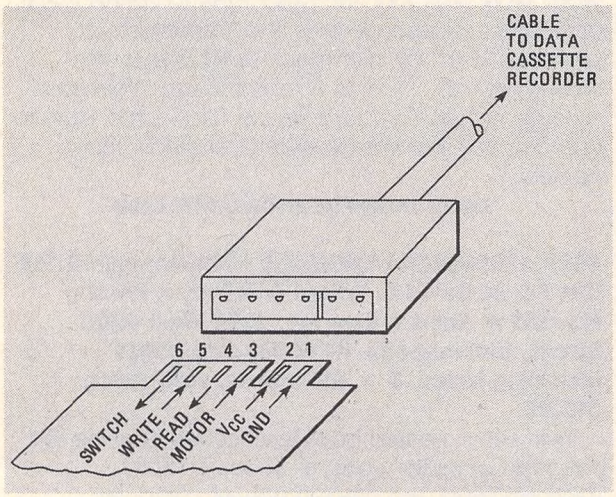


FIG.1—COMPUTER CIRCUIT BOARD edge-connector and cable connector from data cassette recorder showing pin numbers, function names and signal directions.

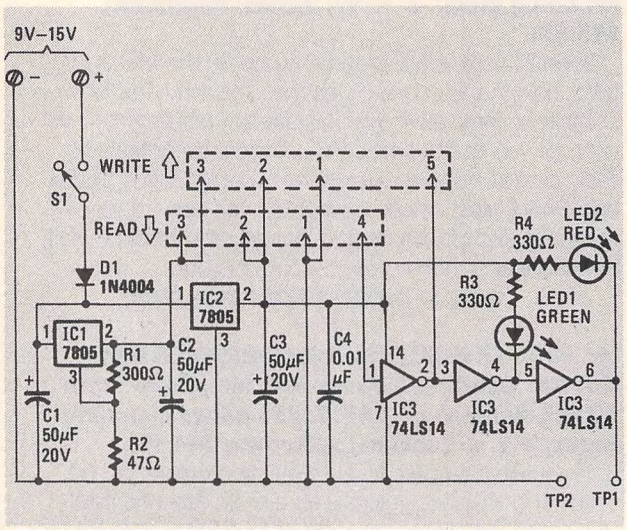


FIG.2—SCHEMATIC DIAGRAM OF INTERFACE through which two Commodore data cassette tape recorders can be interconnected to read out of one and write into the other.

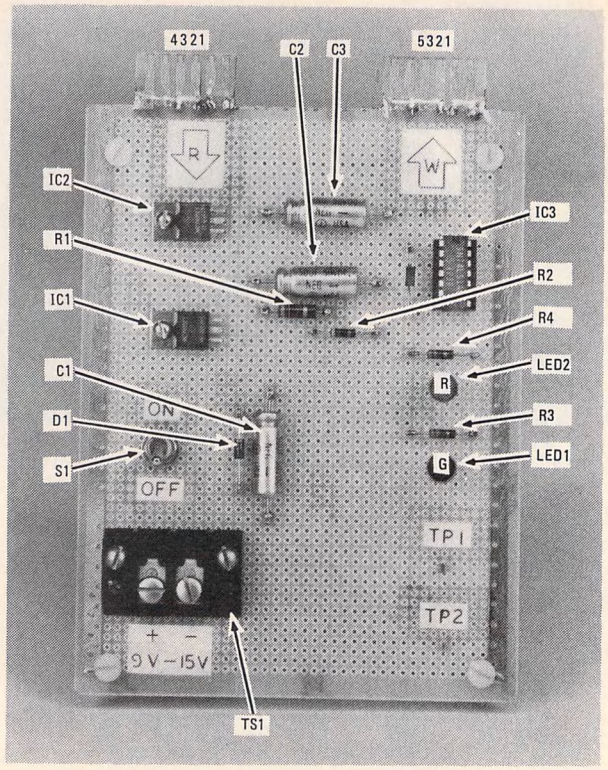


FIG.3—COMPONENT LAYOUT for point-to-point wiring of the interface board.

perfboard having a 22-pin edge connector with 0.156-inch (5/32-inch) spacing between the centers of the connector pins. A coping saw was used to rim the circuit board edge connector to accommodate the cable connectors of two data cassette recorders. A slot must also be cut between pins 2 and 3 so the keyed cable connectors will fit on the circuit board.

Parts layout is not critical. Figure 3 identifies the component locations on the prototype. The components were mounted on flea clips and point-to-point wiring was used. It is advisable to use a 14-pin DIP socket to avoid soldering directly to the pins of IC3 Another perfboard (without an edge connector) was fastened to the bottom of the interface board, using

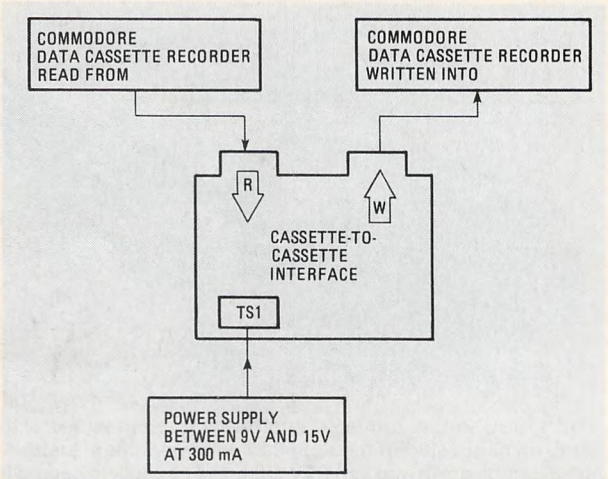


FIG.4—CASSETTE-TO-CASSETTE interface showing connections to power supply and data cassette recorders.

spacers to protect the wiring side of the board.

Testing

After construction is completed, check all wiring and verify that polarized components like D1, C1, C2 and C3 are installed correctly. Leave IC3 out temporarily and connect a power supply to terminal strip TS1 that can provide between 9V and 15V at 300mA (see Fig. 4). Close the power switch S1 and measure the DC voltages between pins 1 and 3 of both READ and WRITE connectors—pin 1 is the ground and pin 3 should be at +6V if IC1 is wired properly. Also measure the voltage between pins 1 and 2 of the connectors—pin 2 should be +5V if IC2 is working correctly. Measure the voltage between pins 7 and 14 of the socket for IC3—pin 7 is ground and pin 14 should be +5V. Open S1 and check that all voltages decrease to 0v.

Plug in IC3 and close S1 again—the red LED2 should be lit. Measure the voltage between pins 1 and 5 of the WRITE connector—pin 5 should be less than +0.5V. Use a clip-lead to short pins 1 and 4 together on the READ connector while still observing pin 5 on the WRITE connector—it should now measure more than +2.7V, the red LED2 should be off and the green LED1 should now be lit.

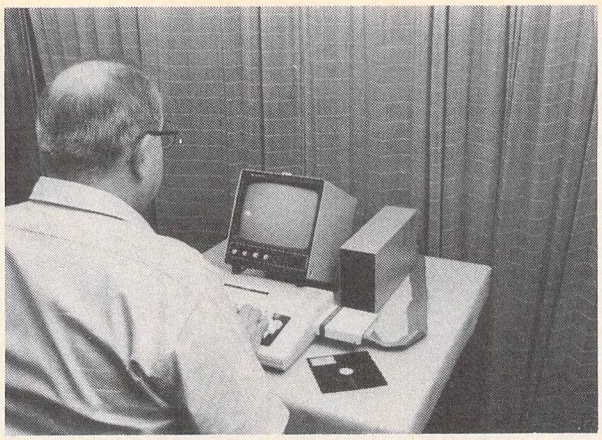
Turn S1 off and connect the READ and WRITE data cassette recorders to the interface board as shown on Figure 4. Insert your master cassette into the READ recorder and a blank cassette into the WRITE recorder. Turn S1 on, push RECORD and PLAY on the WRITE recorder and then push PLAY on the READ recorder.

A small audio amplifier and speaker can be connected across TP1 and TP2 for more convenient monitoring. A high-pitched tone appears on a cassette tape at the beginning of each program. This tone is used to synchronize the computer to the tape during a read operation to allow for variation in tape speed during a read from tape cassette. The sound of data which follows the tone can be described between a hiss and a buzz.◀CD▶

PARTS LIST

Resistors
All resistors are 1/4-watt 10% unless otherwise indicated
R1—300 ohms ± 5%
R2—47 ohms
R3, R4—330 ohms
Capacitors
C1–C3—50 uF, 20 volts electrolytic
Semiconductors
D1—1N4004 Diode
LED1—Green LED
LED2—Red LED
IC3—74LS14 Hex Schmitt-trigger
IC1, IC2—7805 5-volt regulator
Miscellaneous
Plug-in perfboard with 22-pin edge connector with 0.156-inch spacing between centers of connector pins, 14-pin DIP socket, connectors, terminal strip, miniature toggle switch, mounting hardware.

DELUXING THE RADIO SHACK COLOR COMPUTER



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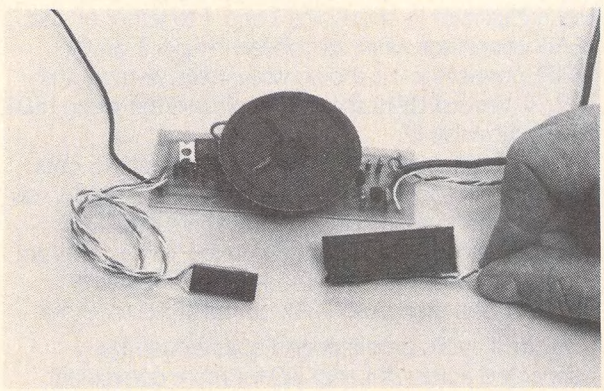
Aftermarket retrofits can upgrade the CoCo to a full business system.

Herb Friedman

■While most home and family computers can be used for little more than games because they are simply too slow or inconvenient for "business use," Radio Shack's Color Computer—affectionately known as the CoCo—can be easily retrofited into a high performance system suitable for "serious" use. Since the CoCo has been a popular gift, chances are there's one tucked away on a shelf because the kids are tired of using it for games. This is the perfect time to upgrade the CoCo so it can be used for business applications—the "serious use."

If you do the upgrade with Radio Shack hardware the system will eventually cost more than it's worth—it would be less expensive to purchase a new "business" computer. But you can come out ahead of the game by using CoCo retrofit kits and components available from non-Radio Shack sources.

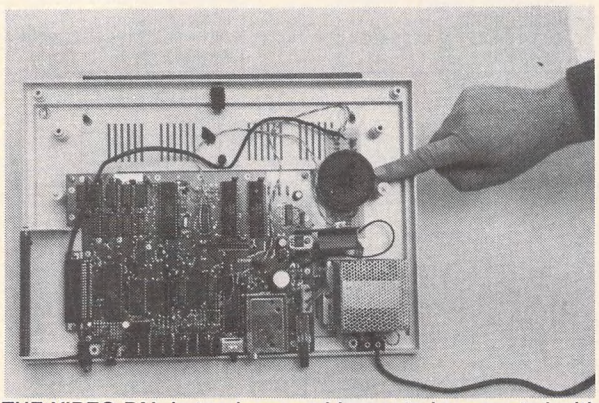
The photographs show how to install the most popular and useful retrofit and upgrades. The computer shown is the latest version of the basic $99 CoCo, the one with minimum BASIC and only 16K of RAM. Since Radio Shack continuously changes the CoCo's design, your model might be different from the model shown in the photographs. In particular, Radio Shack eliminates IC sockets, so certain "plug in" retrofits may have to be soldered in your CoCo.



THE FIRST THING YOU'LL NEED is a composite video output so you can use a conventional monochrome monitor. The Video Pal retrofit provides an external video output and an internal sound system. It is prewired to sockets for the CoCo's video and sound ICs. These components are soldered rather than socketed in the latest CoCo. Mark the wires carefully and unsolder them from the sockets. They will be soldered directly into the CoCo.

Four major upgrades

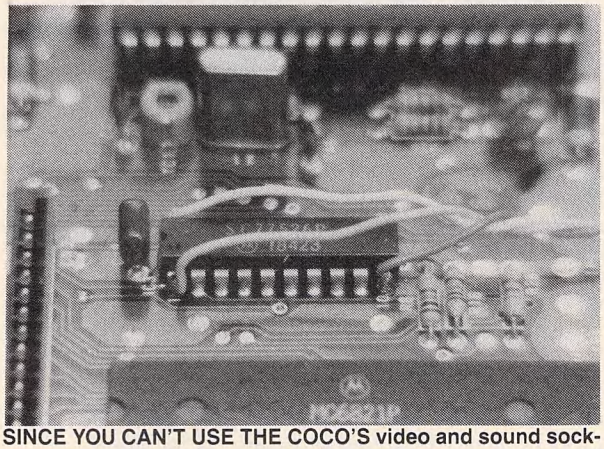
There are four major upgrades for serious use of the CoCo. The first one is a conventional composite video monitor output; the second is expansion to 64k RAM; the third is an upgrade of BASIC to Extended Color Basic; the fourth is the addition of a disk system. Because the CoCo's conventional TV receiver screen display runs out of resolution at about 50 characters, which makes word processing somewhat less than convenient, the composite video monitor output is probably the most important upgrade because it



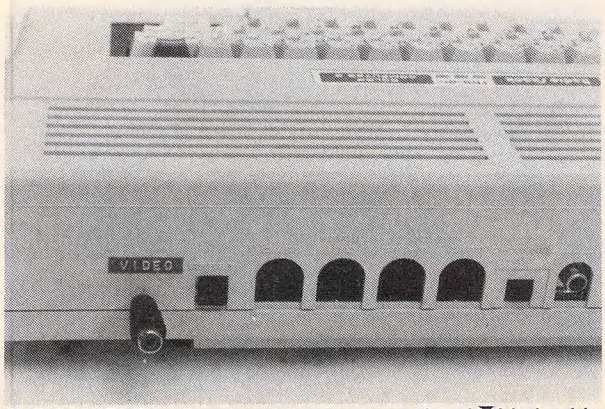
THE VIDEO PAL is too large and heavy to be mounted with tape, as suggested in the supplied documentation. Instead, flip it upside down and use RTV adhesive or caulk to secure it to the case directly in front of the power transformer. (Notice that the keyboard has been removed for protection.)

permits the use of a conventional wideband monochrome monitor that can display up to 80 razor-sharp characters.

Several composite output retrofit kits are available for under $30, The Video Plus Composite Video Interface (Computerware, Box 66, Encinatas, CA 92024) is about the size of a postage stamp and has separate output cables for video and sound. (The sound output can be connected to a small solid-state amplifier.) The Video Pal (RGS Micro, Inc. (Main Street, Derby Line, VT 05830)—the retrofit shown in the photographs, which



SINCE YOU CAN'T USE THE COCO'S video and sound sockets, the connections from the Video Pal must be tack soldered to the terminals of the video and sound ICs. We really mean tack solder: No fancy wraps around the terminals, and the connection is made using a needle-point soldering tip and just a touch of solder. Make certain there are no solder bridges across adjacent terminals.

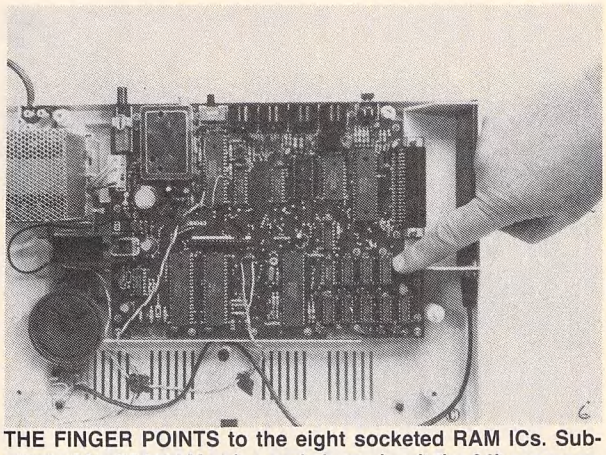


CUT A NOTCH in the rear of the cover so the shielded cable terminated with a phono jack can pass through. The video monitor output can be used simultaneously with the TV output.

also sells for under $30—has a small on-board amplifier and speaker which eliminates the need for an external amplifier.

The RAM upgrade.

64k of RAM is needed for both Extended Color Basic, a disk controller, and decent word processing capability. All you need to do to increase RAM from the supplied 16k to 64k is to substitute 4164 RAM chips for the eight existing RAM ICs and solder a wire across the "64k" solder pads at "J1," which is located at the lower left of the main circuit board. If you get the RAM chips from Spectrum Projects (95-13 86th Drive., Woodhaven, NY 11421) they'll provide RAM upgrade documentation for the various models of the CoCo. While it's easy enough to substitute the 4164s because

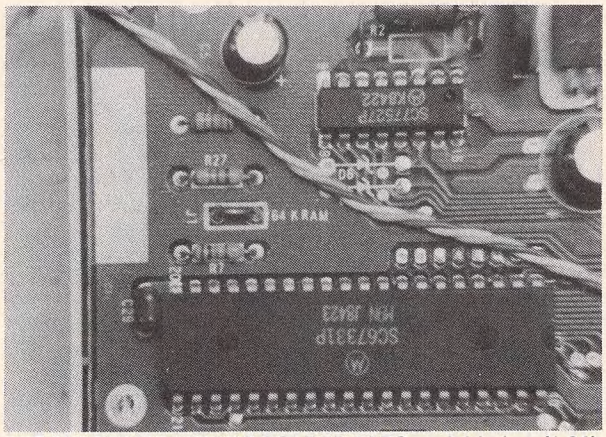


THE FINGER POINTS to the eight socketed RAM ICs. Substitute 64k 4164 RAM chips and short circuit the 64k programming solder pads.

the RAM is socketed, to avoid bending or damaging a terminal the use of an IC insertion tool is recommended. (Don't forget to wear a ground strap when handling ICs.)

Extended color BASIC.

Serious programming, some professional quality software, and a floppy disk system requires the computer to have "Extended Color Basic." A prewired socket for this upgrade is built into the CoCo: All you

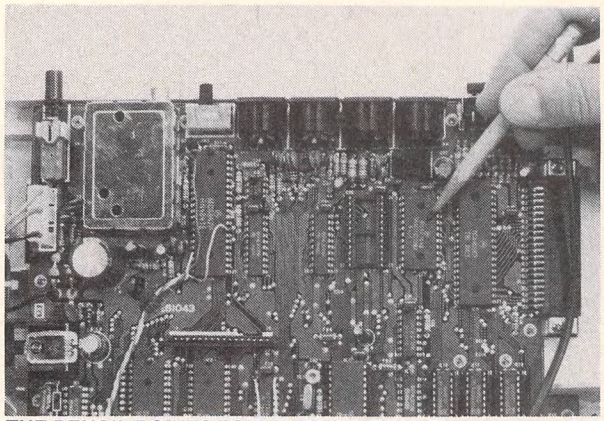


THE 64K PROGRAMMING SOLDER PADS are labled as J1-64k RAM. Just tack solder a small jumper across the pads to program the CoCo for 64k of RAM.

have to do is obtain the IC and plug it in. While Radio Shack stores supposedly sell the part, in reality it's not the easiest thing to get, and Radio Shack charges for an installation you can do yourself in about 60 seconds. (Ten seconds if you already have the cabinet open.) You can purchase the same Extended Color Basic IC with do-it-yourself installation instructions (how to plug it in) from Spectrum Projects and other aftermarket suppliers of parts for the CoCo.

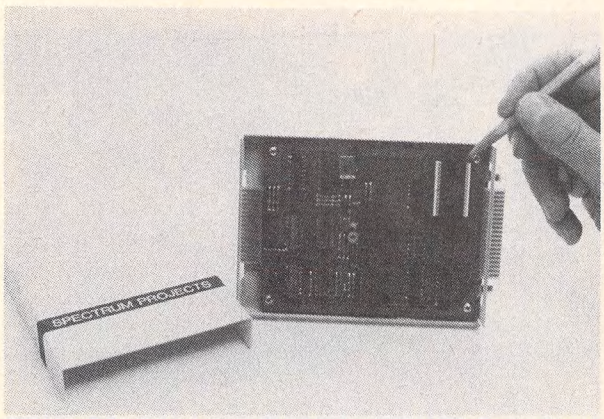
The Floppy disk system.

Finally, we come to a disk controller and disk drives. Any drive that is compatible with IBM, Radio Shack or Zenith computers can be used with the CoCo; in particular, the Shugart SA400, which is flooding the market at ridiculously low prices because it won't work with the newer business-quality computers.



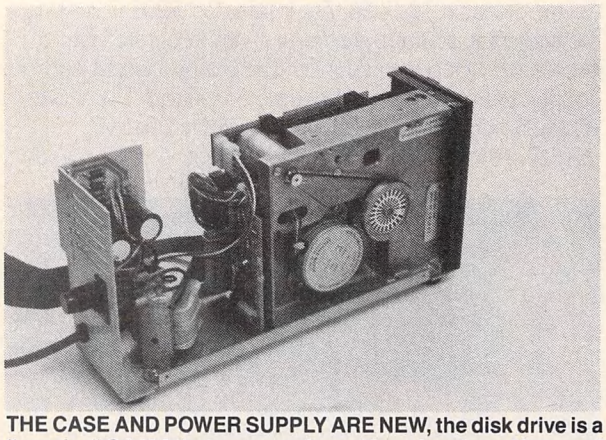
THE PENCIL POINTS TO THE BASIC ROM. The empty socket to its left is for the Extended Color BASIC ROM, which simply plugs into the empty socket. Do it yourself: There's no need for a factory installation of the Extended BASIC ROM.

Combination disk drive cabinet/power supplies can be purchased for under $50 from Software Support, Inc. (One Edgell Rd., Framingham, MA 01701). If you use a presently owned drive, or one of the surplus models such as the SA400, you'll need to provide a disk controller. The best buy is Radio Shack's own controller,



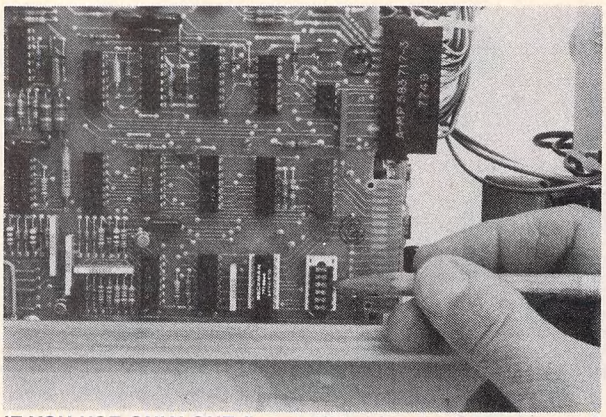
PENCIL POINTS TO THE CLEARLY-LABELLED Radio Shack Disk Controller integrated circuit, the primary reason why most aftermarket disk controllers work so well. But be careful, a controller that doesn't use Radio Shack's IC might not run some of the most popular software.

which as far as I know cannot be purchased independent from a package that also contains the first drive (Drive 0) except from Computer Plus (480 King Street, Littleton, MA 01460). Alternately, you can subsitute an aftermarket disk controller, but unfortunately, one of the best known non-Radio Shack CoCo controllers won't run some of the most popular business-quality software such as Telewriter-64 and most of the Elite line of software. However, other aftermarket disk controllers work well with all software because they actually include the same controller IC that Radio Shack uses. Also, the Radio Shack based controllers function directly with the 30 mSec. drives



THE CASE AND POWER SUPPLY ARE NEW, the disk drive is a "surplus" SA400 that was purchased for a fraction of its usual price. The combination case and power supply sold by Software Support, Inc. has a little extra length and will fit any disk drive we have seen, including most hard disk units.

such as the SA400: The non-Radio Shack controller defaults for the newer mSec. drives and must be programmed for the slower drives. (A 30 Msec, controller works automatically with all drives from 30 to 5 mSec.) If you can't get Radio Shack's controller we suggest you get an aftermarket unit that uses Radio Shack's chip, or one that exactly duplicates the Radio



IF YOU USE ONLY ONE floppy disk drive don't mess around trying to program the disk drive's selector jumpers. If all the DIP jumpers on the drive selector block are left shorted the drive will automatically function as Drive 0. If you want to use two or more drives get one of Radio Shack's preprogrammed disk drive cables and use all jumpers on every drive, but make certain only Drive 0 has a terminating resistor block.

Shack IC. The aftermarket controller shown in the photographs is the DSS ULTRA Controller, which is sold by Spectrum projects (among others).

On with the upgrades.

Let the photographs guide you through the upgrades, but keep in mind that the layout and/or design of your CoCo can be different from the one shown in the photographs.◀CD▶